

Exhibit A-1

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are capable of being modulated with certain information, directly into images and audio for the purposes of transmission and discernment of said information, while effectively being imperceptible and/or unintelligible to a perceiving human. Steganographic solutions currently known to the inventor all place this information "directly" into empirical data (possibly first encrypted, then directly), whereas the methods of this disclosure posit the creation of these (most-often) coextensive carrier signals, the modulation of those carrier signals with the information proper, THEN the direct application to the empirical data.

[0319] In extending these concepts one step further into the application arena of universal code systems, where a sending site transmits empirical data with a certain universal coding scheme employed and a receiving site analyzes said empirical data using the universal coding scheme, it would be advantageous to take a closer look at the engineering considerations of such a system designed for the transmission of images or motion images, as opposed to audio. Said more clearly, the same type of analysis of a specific implementation such as is contained in FIG. 9 and its accompanying discussion on the universal codes in audio applications should as well be done on imagery (or two dimensional signals). This section is such an analysis and outline of a specific implementation of universal codes and it attempts to anticipate various hurdles that such a method should clear.

[0320] The unifying theme of one implementation of a universal coding system for imagery and motion imagery is "symmetry." The idea driving this couldn't be more simple: a prophylactic against the use of image rotation as a means for less sophisticated pirates to bypass any given universal coding system. The guiding principle is that the universal coding system should easily be read no matter what rotational orientation the subject imagery is in. These issues are quite common in the fields of optical character recognition and object recognition, and these fields should be consulted for further tools and tricks in furthering the engineering implementation of this technology. As usual, an immediate example is in order.

[0321] Digital Video And Internet Company XYZ has developed a delivery system of its product which relies on a non-symmetric universal coding which double checks incoming video to see if the individual frames of video itself, the visual data, contain XYZ's own relatively high security internal signature codes using the methods of this technology. This works well and fine for many delivery situations, including their Internet tollgate which does not pass any material unless both the header information is verified AND the in-frame universal codes are found. However, another piece of their commercial network performs mundane routine monitoring on Internet channels to look for unauthorized transmission of their proprietary creative property. They control the encryption procedures used, thus it is no problem for them to unencrypt creative property, including headers, and perform straightforward checks. A pirate group that wants to traffic material on XYZ's network has determined how to modify the security features in XYZ's header information system, and they have furthermore discovered that by simply rotating imagery by 10 or 20 degrees, and transmitting it over XYZ's network, the network doesn't recognize the codes and therefore does not flag illicit uses of their material, and the receiver of the pirate's rotated material simply unrotates it.

[0322] Summarizing this last example via logical categories, the non-symmetric universal codes are quite acceptable for the "enablement of authorized action based on the finding of the codes," whereas it can be somewhat easily by-passed in the case of "random monitoring (policing) for the presence of codes." [Bear in mind that the non-symmetric universal codes may very well catch 90% of illicit uses, i.e. 90% of the illicit users wouldn't bother even going to the simple by-pass of rotation.] To address this latter category, the use of quasi-rotationally symmetric universal codes is called for. "Quasi" derives from the age old squaring the circle issue, in this instance translating into not quite being able to represent a full incrementally rotational symmetric 2-D object on a square grid of pixels. Furthermore, basic considerations must be made for scale/magnification changes of the universal codes. It is understood that the monitoring process must be performed when the monitored visual material is in the "perceptual" domain, i.e. when it has been unencrypted or unscrambled and in the form with which it is (or would be) presented to a human viewer. Would-be pirates could attempt to use other simple visual scrambling and unscrambling techniques, and tools could be developed to monitor for these telltale scrambled signals. Said another way, would-be pirates would then look to transform visual material out of the perceptual domain, pass by a monitoring point, and then transform the material back into the perceptual domain; tools other than the monitoring for universal codes would need to be used in such scenarios. The monitoring discussed here therefore applies to applications where monitoring can be performed in the perceptual domain, such as when it is actually sent to viewing equipment.

[0323] The "ring" is the only full rotationally symmetric two dimensional object. The "disk" can be seen as a simple finite series of concentric and perfectly abutted rings having width along their radial axis. Thus, the "ring" needs to be the starting point from which a more robust universal code standard for images is found. The ring also will fit nicely into the issue of scale/magnification changes, where the radius of a ring is a single parameter to keep track of and account for. Another property of the ring is that even the case where differential scale changes are made to different spatial axes in an image, and the ring turns into an oval, many of the smooth and quasi-symmetric properties that any automated monitoring system will be looking for are generally maintained. Likewise, appreciable geometric distortion of any image will clearly distort rings but they can still maintain gross symmetric properties. Hopefully, more pedestrian methods such as simply "viewing" imagery will be able to detect attempted illicit piracy in these regards, especially when such lengths are taken to by-pass the universal coding system.

[0324] Rings to Knots

[0325] Having discovered the ring as the only ideal symmetric pattern upon whose foundation a full rotationally robust universal coding system can be built, we must turn this basic pattern into something functional, something which can carry information, can be read by computers and other instrumentation, can survive simple transformations and corruptions, and can give rise to reasonably high levels of security (probably not unbreakable, as the section on universal codes explained) in order to keep the economics of subversion as a simple incremental cost item.

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unless both the header information is verified AND the in-frame universal codes are found. However, another piece of their commercial network performs mundane routine monitoring on Internet channels to look for unauthorized transmission of their proprietary creative property. They control the encryption procedures used, thus it is no problem for them to unencrypt creative property, including headers, and perform straightforward checks. A pirate group that wants to traffic material on XYZ's network has determined how to modify the security features in XYZ's header information system, and they have furthermore discovered that by simply rotating imagery by 10 or 20 degrees, and transmitting it over XYZ's network, the network doesn't recognize the codes and therefore does not flag illicit uses of their material, and the receiver of the pirate's rotated material simply unrotates it.

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Rings to Knots

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One current preferred embodiment of the "ring-based" universal codes is what the inventor refers to as "knot patterns" or simply "knots," in deference to woven Celtic knot patterns which were later refined and exalted in the works of Leonardo Da Vinci (e.g. Mona Lisa, or his knot engravings). Some rumors have it that these drawings of knots were indeed steganographic in nature, i.e. conveying messages and signatures; all the more appropriate. FIGS. 18 and 19 explore some of the fundamental properties of these knots.

Two simple examples of knot patterns are depicted by the supra-radial knots, 850 and the radial knots 852. The names of these types are based on the central symmetry point of the displayed rings and whether the constituent flags intersect this point, are fully outside it, or in the case of sub-radial knots the central point would be inside a constituent circle. The examples of 850 and 852 clearly show a symmetrical arrangement of 8 rings or circles. "Rings" is the more appropriate term, as discussed above, in that this term explicitly acknowledges the width of the rings along the radial axis of the ring. It is each of the individual rings in the knot patterns 850 and 852 which will be the carrier signal for a single associated bit plane in our N-bit identification word. Thus, the knot patterns 850 and 852 each are an 8-bit carrier of information. Specifically, assuming now that the knot patterns 850 and 852 are luminous rings on a black background, then the "addition" of a luminous ring to an independent source image could represent a "1" and the "subtraction" of a luminous ring from an independent source image could represent a "0." The application of this simple encoding scheme could then be replicated over and over as in FIG. 19 and its mosaic of knot patterns, with the ultimate step of adding a scaled down version of this encoded (modulated) knot mosaic directly and coextensively to the original image, with the resultant being the distributable image which has been encoded via this universal symmetric coding method. It remaining to communicate to a decoding system which ring is the least significant bit in our N-bit identification word and which is the most significant. One such method is to make a slightly ascending scale of radii values (of the individual rings) from the LSB to the MSB, another is to merely make the MSB, say, 10% larger radius than all the others and to pre-assign counterclockwise as the order with which the remaining bits fall out. Yet another is to put some simple hash mark inside one and only one circle. In other words, there are a variety of ways with which the bit order of the rings can be encoded in these knot patterns.

The preferred embodiment for the decoding of, first of all checking for the mere existence of these knot patterns, and second, for the reading of the N-bit identification word, is as follows. A suspect image is first Fourier transformed via the extremely common 2D FFT computer procedure. Assuming that we don't know the exact scale of the knot patterns, i.e., we don't know the radius of an elemental ring of the knot pattern in the units of pixels, and that we don't know the exact rotational state of a knot pattern, we merely inspect